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names. For human anatomy there comes Waldeyer of Berlin; for comparative anatomy, Fuerbringer of Heidelberg; for embryology, Hertwig of Berlin; for physiology, Engelmann of Berlin; for neurology, Erb of Heidelberg; for pathology, Marchand of Leipzig; for pathological anatomy, Orth of Berlin; for biology, Weismann of Freiburg; for botany, Goebel of Munich; for mineralogy, Zirkel of Leipzig; for geography, Gerland of Strassburg; for physical chemistry, Van't Hoff of Berlin; for physiological chemistry, Kossel of Heidelberg; for geophysics, Weichert of Göttingen; for mechanical engineering, Riedler of Berlin; for chemical technology, Witt of Berlin, and so on. Or to turn to the department of Professor Dewey: For history of philosophy, Windelband of Heidelberg; for logic, Riehl of Halle; for philosophy of nature, Ostwald of Leipzig; for methodology of science, Erdmann of Bonn; for aesthetics, Lipps of Munich; for psychology, Ebbinghaus of Breslau; for sociology, Toennies of Kiel; for social psychology, Simmel of Berlin; for ethnology, von den Steinen of Berlin; for pedagogy, Ziegler of Strassburg. Or to mention some other departments: Among the philologists I notice Brugman of Leipzig, Paul of Munich, Delitzsch of Berlin; Sievers of Leipzig, Kluge of Freiburg, Muncker of Munich; Oldenberg of Kiel and others. Among the economists, Schmoller of Berlin, Weber of Heidelberg, Stieda of Leipzig, Conrad of Halle, Sombart of Breslau, Wagner of Berlin. Among the jurists, Binding of Leipzig, Zorn of Bonn, Jellineck of Heidelberg, von Lizst of Berlin, Wach of Leipzig, von Bar of Göttingen, Kahl of Berlin, Zitelmann of Bonn, and so on. Among the theologians, Harnack of Berlin, Budde of Marburg, Pfeiderer of Berlin. For classical art, Furtwaengler of Munich; for modern art, Muther of Breslau; for mediæval history, Lamprecht of Leipzig. Enough of the enumeration. The list from England and from France is on the same level, and I anticipate that when we soon shall send out invitations to several hundred Americans for definite addresses, their response will not be less general, their list not less noble. But American par-

ticipation is a question of the future. The list of acceptances which I have given here stands as a matter of fact beyond discussion. Is there really any doubt still possible that we have secured on the basis of that disastrous program the greatest combination of leaders of thought which has ever been brought together? When we three came home from our European mission after four months of hard labor to secure this result surpassing our own expectations, we might have felt justified in the hope that scientific men of this country would welcome us otherwise than with the cry, that we, under the guise of science, have made science ridiculous. HUGO MÜNSTERBERG.

HARVARD UNIVERSITY,
October 12, 1903.

SHORTER ARTICLES.

A PLEA FOR BETTER ENGLISH IN SCIENCE.

THAT to genuine scholarship is not always conjoined power of expression is common knowledge. Not a few men who have received academic training and have been honored with university degrees, who have explored profound mysteries of nature and discovered hidden laws, seem to be incapable of clearly explaining the processes they employ in their researches or of plainly setting forth their discoveries.

Not long ago a contributor to *The Critic* said:

The development of scientific method is alleged to be one of the foremost characteristics of the present century. Philologists will ransack the earth, if not the heavens, for exact information as to date and authorship of even the fragments of ancient literature; botanists will tramp the forests for months to verify or disprove the rumor of a new orchid, and astronomers will go to any accessible point on the face of the globe for more exact figures on an eclipse or a transit of Venus. We might expect, then, to find a corresponding effort for exactness in the expression of thought, but an examination of the evidence is not altogether encouraging.

A few months ago a Boston editor published the following paragraph:

The English language is suffering violence in many ways. Among those who are forgetting its

grace and beauty, the elements of its power, and the right use of it, are the students of pure and applied science, who, being eager in youth to get at their work directly, despise such mere scholastic accomplishments as rhetoric, grammar and logic. The result often is that, when they have discovered something which they are eager to give to the world and which the world ought to know, they have no vehicle of language and style worthy to convey their noble facts and great ideas to the public. * * * Many a scientific man has learned in middle life, with bitter regret, that he must take a lower place than he deserves among his fellow-workers because he can not tell what he knows in language that is intelligible and attractive. Others have been hindered in their course, and never knew the reason why.

But worse than inability to write vigorously and pleasingly is the widespread lack of appreciation of clear and precise expression. De Quincey, in his celebrated essay on 'Style,' said, referring especially to professional authors:

Proof lies before you, spread out upon every page, that no excess of awkwardness, or of inelegance, or of unrhythymical cadence, is so rated in the tariff of faults as to balance, in the writer's estimate, the trouble of remoulding a clause, of interpolating a phrase, or even of striking a pen through a superfluous word. The evidence is perpetual, not so much that they rest satisfied with their own random preconceptions of each clause or sentence, as that they never trouble themselves to form any such preconceptions. Whatever words tumble out under the blindest accidents of the moment, those are the words retained.

In his 'Principles of Success in Literature,' George Henry Lewes, referring to the writings of philosophers and men of science, said:

If you allude in their presence to the deplorably defective presentation of the ideas in some work distinguished for its learning, its profundity, or its novelty, it is probable that you will be despised as a frivolous setter up of manner over matter, a light-minded dilettante, unfitted for the simple austereities of science. But this is itself a light-minded contempt; a deeper insight would change the tone, and help to remove the disgraceful slovenliness and feebleness of composition which deface the majority of grave works, except those written by Frenchmen, who have been taught

that composition is an art, and that no writer may neglect it.

If these strictures are just, the subject demands attention.

I am well acquainted with the writings, as found in manuscripts submitted for publication, of about one hundred scientists, young, middle-aged and old. One is justified in supposing that on such manuscripts the authors have done their best work. I have classified these authors in three groups: Good, fair, poor—'good' meaning those whose writing is clear, orderly and forcible; 'fair' meaning those whose writing is, indeed, clear and passably methodical, but is not forcible; and 'poor' meaning those whose writing is turbid or chaotic or has other defects which render it of little value, such as extreme verbosity. In the good group fall 19 per cent., in the fair group 57 per cent. and in the poor group 24 per cent. That is to say, neglecting such formal bagatelles as the split infinitive, and merging the details of purity, propriety and precision in the larger qualities, I find that fewer than one fifth of these authors write with clearness, method and force, and that almost one fourth of them do not write even clearly.

Into this evaluation there enters, of course, whatever weakness may reside in my individual judgment. I am sure, however, that the finding is not vitiated by prejudice or favoritism, conscious or unconscious; and in making the assignments to the three classes I gave every author the benefit of a doubt.

Of these men about 75 per cent. have had collegiate or university training; their almae matres are our leading universities and schools of science. No fewer than twenty of them are now professors or instructors in such institutions of learning, and most of these fall in the fair class: their writing is not strong. In a few cases it is markedly weak; in other cases there is manifested an abundance of energy, but it is not under good control. In the good class there is at least one who is self-educated. Thus it appears that scientific and university life, with the

preparation in lower schools which this implies, does not insure good English.

If the results given seem somewhat depressing, let us take courage from the Frenchman who declared that 'it needs more delicate tact to be a great writer than a great thinker,' and inquire whether, after all, the condition presented is markedly exceptional.

It is probable that if any other large body of writers were similarly classified they would not make a much better showing. My evaluation, unlike that of the writers quoted, is of *manuscripts* as they are received from the authors. Literature of belletristic character, having little if any immediately practical or economic content, is necessarily dependent for existence upon its intrinsic merit and must be at least fair if it is accepted for publication. On the other hand, many abominably written scientific papers are so richly laden with the results of observation and experiment that they are given prompt publication—so prompt that they can receive but a modicum of editorial attention. That is to say, nearly everything written by men of science is published, whereas only the supposed cream of 'polite' productions is thus honored. If practically all that is written in the line of novels, of essays or of poetry were published, the 'poor' percentage would doubtless be higher than twenty-four.

Although, therefore, scientific writing, relatively considered, is not in a desperate plight, its condition is bad enough and is, I believe, susceptible of no little improvement. Recognizing that the able writer is born rather than made—that the chief requisites are, as Herbert Spencer has said, a sense of logical dependence, constructive ingenuity, a good verbal memory and a sensitive ear, and that these qualities are largely innate—I nevertheless believe that in many cases the ability is present but is never used; it lies dormant, and could be awakened and brought into service. What it needs is appreciation and utilization. "In England and Germany," says Lewes, "men who will spare no labor in research, grudge all labor in style; a morning is cheerfully devoted to verifying a quotation

by one who will not spare ten minutes to reconstruct a clumsy sentence; a reference is sought with ardor, an appropriate expression in lieu of the inexact phrase which first suggests itself does not seem worth seeking. What are we to say to a man who spends a quarter's income on a diamond pin which he sticks in a greasy cravat?" One can hardly escape the conviction that this criticism applies to America as well as to England and Germany.

It is true that, according to the figures, a large majority write clearly, but clearness alone is not sufficient. Sentences and paragraphs may themselves be perfectly clear, but the ideas they clothe be so inconsequential if not inconsequential, that their total effect on the reader is weariness. Effective composition implies sequence and unity, symmetry and proportion. Vital writing, whether it be a sentence, a paragraph or a disquisition, is characterized by structure and integrity. Such are the famous paragraphs of Macaulay, whose 'astonishing power of arranging facts and bringing them to bear on any subject * * * joined with a clear and vigorous style,' says McMaster, 'enabled him to produce historical scenes with a grouping, a finish and a splendor to which no other writer can approach'; such are the exquisite essays of Lowell, who 'added to the love of learning the love of expression'; and such are the philosophical dissertations of Herbert Spencer, whose power of presentation is remarkable. Schopenhauer classified authors into three kinds: "First," said he, "come those who write without thinking. They write from a full memory, from reminiscences. This class is the most numerous. Then come those who do their thinking while they are writing, and there is no lack of them. Last of all come those writers who think before they begin to write; they are rare." If Addison's definition of good writing (a definition which was warmly endorsed by Hume)—that it consists in the expression of sentiments or ideas which are natural but not obvious—is valid, it is apparent why the productions of authors who fall in the first class are poor: the lucid statement of relations which are not obvious

requires thought. Papers by writers of this class are inevitably amorphous and weak. If those by the second class do exhibit power, the power is apt to be lawless, and the tectonics are likely to be distractingly apparent to the reader. Only papers by the third class can possess structure and grace. Schopenhauer declares further that an author's style is an exact expression of his mode of thought; that it shows the formal nature—which must always remain the same—of all the thoughts of a man; and, therefore, that when he has read a few pages of an author, whatever the subject, he knows about how far that author can help him. Similarly wrote Dean Alford in his 'Plea for the Queen's English': "If the way in which men express their thoughts is slipshod and mean, it will be very difficult for their thoughts themselves to escape being the same."

Again, effective composition implies concentration, distillation, a process akin to chemical rectification; and this it is that energizes. Josh Billings said: "I don't care how much a man talks if he only says it in a few words." Lecky calls this power the supreme literary gift of condensation, which Gibbon possessed in so high degree. In the case of a talented writer this process is subconscious and rapid, but others achieve the result through conscious effort if not downright labor. Macaulay made almost endless changes, both of matter and of style. Said Joubert: "If there is a man tormented by the accursed ambition to put a whole book into a page, a whole page into a phrase, and that phrase into a word, it is I." Little wonder that Joubert has succeeded La Rochefoucauld as the most famous coiner of aphorisms. John Burroughs has lately said, in his 'Literary Values': "There is a sort of mechanical equivalent between the force expended in compacting a sentence and the force or stimulus it imparts to the reader's mind. * * * So much writing there is that is like half-live coals buried in ashes—dead verbiage." Spenser, in his essay on 'The Philosophy of Style,' observes that the strongest effects are produced by interjections, which condense en-

tire sentences into syllables, and that signs are still more forcible. For instance, to say 'Leave the room' is less expressive than to point to the door. Doubtless science would make slow progress if obliged to use the sign language; yet in the prolixity and tenuity which characterize much of the scientific writing of the day there is no progress, but only vexation of the spirit of the reader. "It is with words as with sunbeams," says Saxe, "the more they are condensed the deeper they burn." In sententiousness there is strength. We feel it in the epigrammatic sentences of Emerson, who wrote to Carlyle of 'paragraphs incompressible,' and most of whose titles are single words. On the other hand, some of Kant's sentences have been measured by a carpenter and been found to run two feet eight by six inches. "A sentence with that enormous span," says De Quincey, "is fit only for the use of a megatherium."

As an example of scientific writing which is not only clear and methodical, but forcible, I may mention that of the late George H. Williams, in whose untimely death the scientific world suffered a loss.

That clearness and force are desiderata in scientific writing will be admitted by all. It may be somewhat rash, however, even to mention in such connection a higher quality; but I observe that into this article the words 'grace' and 'beauty' have already crept and I am not disposed to cancel them. Says Joubert: "In the mind of certain writers nothing is grouped or draped or modeled; their pages offer only a flat surface on which words roll." Says Lewes: "A man must have the art of expression or he will remain obscure." Says Buffon: "Only well-written works will survive; abundance of knowledge and singularity of facts are not a guaranty of immortality."

Rhetoric, we know, was to Huxley an abomination—a vile cosmetic; yet it is not difficult to discover in Huxley's writings pages that are rhetorically elegant. The fact that with him the action was spontaneous is merely evidence of his artistic endowment; and there can be no doubt that his shafts were hurled at the foolishness of literary foppery, not at

that natural grace of style which, like elegance of manners, can be felt but not analyzed. Doubtless the technical description of a dinosaur or of an aboriginal shell-heap can derive little aid from metonymy or climax; but the field of the scientific specialist merges insensibly in common ground, and when he is on the borders he is within view of the whole world of letters. Moreover, the man of science often takes literary excursions into neighboring provinces—at least many of the great men of science do. Witness Huxley himself, with his ‘Lay Sermons’; and John Tyndall, who almost made a specialty of feeding ‘Fragments’ to the unscientific, and whose fame is due chiefly to his brilliant advocacy, oral and in writing, of physical science; and Ernst Haeckel, with his ‘Riddle of the Universe.’

“The importance of style,” says Lewes, “is generally unsuspected by philosophers and men of science, who are quite aware of its advantage in all departments of *belles lettres*. * * * Had there been a clear understanding of style as the living body of thought, and not its ‘dress’ * * * the error I am noticing would not have spread so widely. The matter is confluent with the manner, and only through the style can thought reach the reader’s mind.” Here Lewes but repeats De Quincey, who cites Wordsworth to the effect that it is the highest degree unphilosophical to call language or diction ‘the dress of thought’; Wordsworth would call it the *incarnation* of thought. ‘Never in one word,’ says De Quincey, ‘was so profound a truth conveyed.’

Of the authors whose writings I have classified as ‘good,’ there are five or six whose writings I should place in the highest class, that of excellent; for to the characteristics of clearness, orderliness and forcibleness they add the final quality of elegance or attractiveness. As an example of scientific writing of this class, mention may be made of that of the late Dr. John S. Newberry. If one doubts it one should read his paper on ‘The Ancient Lakes of Western North America,’ in the Fourth Hayden Annual.

Scientific men, especially the young men, are prone to spend most of their time in observing and experimenting; comparatively little is devoted to studying the accumulated data and their relations, and little indeed is reserved for composition. Phenomena are sought with eagerness, but, once discovered, interest in them wanes. The field and the laboratory are too alluring to be resisted for long, and the time to be devoted to reflection and to writing is minimized. Neglecting what Coleridge termed ‘ratiocinative meditation,’ they produce with facility papers consisting of crude raw materials which can but repel persons endowed with a sense of order, strength and beauty. Doubtless these writers are, as Henry James says, ‘strangers to the pangs and the weariness that accompany the sense of exactitude, of proportion and of beauty,’ but in many cases it is also true that they are writers who ‘have been hindered in their course and never knew the reason why.’ I appeal to the scientific men of America, especially the younger men, to cast off this shameful indifference to the power and beauty of their marvelously rich and adaptable language, and to devote to their writing some of the energy they manifest in the field and some of the patience they exercise in the laboratory.

In a recently issued university catalogue, under the heading ‘Admission’ and the sub-heading ‘English,’ appears the following item of gratifying information: “The candidate should read all the prescribed books, but knowledge of them will be regarded as less important than ability to write English.” That a young man entering on a scientific course at a university should have read carefully ‘Silas Marner’ and ‘The Sir Roger de Coverley Papers’ is doubtless desirable, but that he should be able to express, in English that is at least clear and vigorous, whatever he may know on any subject is of far more importance. Without the property of reversibility, giving the motor, the dynamo-electric machine would lack the greater portion of its usefulness. Though a man be surcharged with knowledge, his usefulness to mankind must be slight unless he is able to

impart the knowledge through the medium of clear and forcible language; and there are indications that both the preparatory schools and the universities are awaking to a realization of this fact.

P. C. WARMAN.

A CONTRIBUTION TO THE CRANIOLOGY OF THE PEOPLE OF SCOTLAND.*

UNDER this title Professor Sir William Turner, than whom no one is better qualified to deal with this subject, presents the first systematic account of the cranial characters of the people of Scotland. The study is based on 176 carefully gathered skulls (117 males and 59 females) obtained principally in the counties south of the Clyde and Tay ('lowland Scotland').

The memoir is written in the same clear style, eminently fit for instruction, which marks all the works of this author, and the results of the study are of much interest. These results are briefly summarized as follows:

"The Scottish cranium is large and capacious; the vertex is seldom heeled or roof-like, but has a low rounded arch in the vertical transverse plane at and behind the bregma." The side walls "bulge slightly outwards in the parieto-squamous region, so that the greatest breadth is usually at or near the squamous suture. The occipital squama bulges behind the inion." The glabella and supraorbital ridges, in men, 'are fairly but not strongly pronounced, the forehead only slightly recedes from the vertical plane and the nasion is scarcely depressed.'

From the "analysis of the cephalic indices, it would appear that a brachycephalic type of skull prevailed in Fife, in the Lothians, in the northeast counties of Forfar, Kincardine and Banff; and it occurred to some extent in Shetland, in Ayr, in the border county of Peebles, and in Stirlingshire."

"The dolichocephalic type of skull was feebly represented in Fife; it was proportionally more numerous in the Lothians; it

was represented in Lanark, Ayr, Shetland and the Hebrides. It formed the prevailing type in Wigtonshire, in Caithness, in the skulls from the Highland counties, and in the important series of skulls from Renfrewshire."

The vertical diameter—basion-bregma—(mean, in males, 132.4 mm.), was only in two out of 150 of the Scottish crania in which the measurement would be taken in excess of the breadth; the two measurements were equal in four others, while 'in all the rest, whether cephalic index was high or low, the vertical diameter was less than the breadth.' 'The Scottish skulls are platychamæcephalic.'

Among the 73 male and 42 female crania that were cubed (with shot, according to Turner's method), 'the maximum capacity in the male skulls was 1,855 c.c., the minimum was 1,230 c.c., and the mean was 1,478 c.c.'; 'the maximum in the female was 1,625 c.c., the minimum 1,100 c.c. and the mean 1,322 c.c.' Apparently the Scottish male skull is 'somewhat in excess of the mean ascribed to the crania of European men.' The female skull, similarly as in other races and people, is about ten per cent. less capacious than the male.' 'In twenty-five male dolichocephalic crania the mean capacity was 1,516 c.c.'; in twenty-one male crania of cephalic index 'from 75 to 77.4, the mean capacity was 1,519 c.c.'; in fifteen with cephalic index of '77.5 to 79.9, the mean capacity was 1,452 c.c.'; and 'in thirteen brachycephalic skulls the mean capacity was 1,469 c.c.' The Scottish skulls 'with dolichocephalic proportions had a distinctly greater mean capacity than the brachycephalic.'

The highest mean cranial capacity was given in the males, 'by the skulls from Fife, Mid-Lothian, Shetland and Renfrewshire'; while the mean was lowest in the skulls 'from Edinburgh and Leith, West Lothian, the northeastern counties, the highland counties and the dissecting-room.'

"The face was usually orthognathous, sometimes mesognathous; the nose was prominent, long and narrow, leptorrhine; the orbits had usually the vertical diameter high in relation to the transverse, mesoseme or megaseme; the

* *Trans. Roy. Soc. Edinburgh*, Vol. XL., Part III., No. 24, 1903.